DECLARATION

Applicant: Shoji et al.

Serial No.: U.S. Patent Application No. 10/599,435

Filed: March 23, 2005.

For: METHOD FOR CONTROLLING AVERAGE PORE DIAMETER OF POROUS BODY COMPRISING APATITE/COLLAGEN COMPOSITE FIBERS

Art Unit: 1796

Examiner: WANG, CHUN CHENG

DECLARATION UNDER 37 CFR § 1.132

Honorable Commissioner of
Patents and Trademarks
Washington, D.C. 20231

Dear Sir:

I, Daisuke Shoji, a citizen of Japan, declare that:

(1) I am one of the inventors listed in the above-identified application.

(2) I reside at 3-25-9 Tokiwadai, Itabashi-ku, Tokyo 174-0071, Japan.

(3) I graduated from Nagaoka University of Technology, Engineering in 1999, specializing in Material Science and Technology, and further studied at Nagaoka University of Techonology , from 1999 to 2001, specializing in Material Science and Technology.

(4) I was employed by PENTAX CORPORATION since 2001.

(5) I am currently in the position of R and D department, New ceramics Division of HOYA CORPORATION.

(6) I understand the present invention and the prosecution history of the above-identified application.

(7) I have reviewed a Final Office Action dated June 6, 2010 and the prior art document Kikuchi et al. ("Porous Body Preparation of

Hydroxyapatite/Collagen Nanocomposites for Bone Tissue Regeneration, Key Engineering Materials, Vols 254-256 (2004), pp561-564) cited by the Examiner.

(8) Although Kikuchi clearly disclose using freezing temperature to control the pore size of the fibrous apatite/collagen composite, Kikuchi is silent about that by using "the solidification time" as a parameter to control the relation between the average pore diameter and the freezing-environment temperature, concretely, by using a graph of the solidification time and the average pore diameter and a graph of the freezing-environment temperature and the solidification time, precise control of the average pore diameter of the apatite/collagen porous body can be achieved.

Considering the features of Kikuchi, the amended claim 1 is as follow:

1. (currently amended): A method for controlling the average pore diameter of a porous body comprising a fibrous apatite/collagen composite, said porous body produced by:

gelating a dispersion comprising said fibrous apatite/collagen composite, collagen and water;

freeze-drying the resultant gel to form a porous body; and

cross-linking collagen in said porous body;

wherein the average pore diameter of the porous body is controlled by the steps in series of

frozing pluralities of the gels at various freezing-environment temperatures and measuring the solidification time of each gel to prepare a graph showing the relation between the freezing-environment temperature and the solidification time,

measuring the average pore diameter of the porous body obtained at various lengths of solidification time to prepare a graph showing the relation between the solidification time and the average pore diameter,

determining the solidification time for providing a desired average pore diameter of said porous body from the graph of the solidification time and the average pore diameter, and

determining the freezing-environment temperature for achieving the

determined solidification time from the graph of the freezing-environment temperature and the solidification time.

(9) The above amended claim 1 is considered to be advantageous over Kikuchi, especially when data for the relations among the freezing-environment temperature, the solidification time and the average pore diameter, are deviated from straight lines as those in Example 2 shown in Figs. 6 and 8 because it is difficult to determine the freezing-environment temperature accurately from the targeted average pore diameter.

Therefore, for the purpose to demonstrate that the method of the invention recited in the amended claim 1 is advantageous over the direct method disclosed in Kikuchi, I performed the following experimentation in addition to Example 2.

[A] Experimentation

(a) Porous bodies (d-2) and (e-2) each containing a fibrous apatite/collagen composite were produced in the same manner as in Example 2, except that the freezing-environment temperature T_0 were -70°C and -35°C, respectively.

The the solidification time Sb and the average pore diameter of each porous body were measured by the same method as in Example 2. The results are shown in Table 1 below.

Table 1

Porous Body	Freezing-Environment Temperature T_0 (°C)	Solidification Time Sb (seconds)	Average Pore Diameter (μm)
(d-2)	-70	925	138.0
(e-2)	-35	2175	511.6

Combining the above result with the result in Example 2, Figs. 6A, 8A and 9A are made as below:

Fig. 6A shows the relation between the freezing-environment temperature T_0 (temperature in the freezer) and the solidification time Sb in

the porous bodies (a-2), (b-2), (c-2), (d-2) and (e-2), Fig. 8A shows the relation between the solidification time Sb and the average pore diameter D_{AV} in the porous bodies (a-2), (b-2), (c-2), (d-2) and (e-2), and Fig. 9A shows the relation between the freezing-environment temperature T_0 and the average pore diameter D_{AV} in the porous bodies (a-2), (b-2), (c-2), (d-2) and (e-2).

Fig. 6A

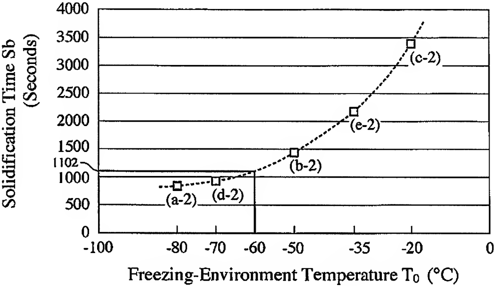


Fig. 8A

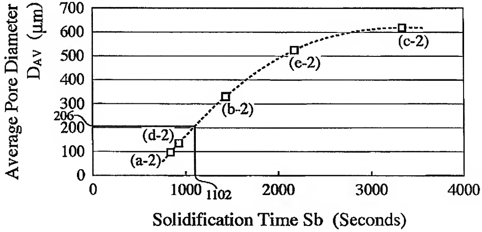
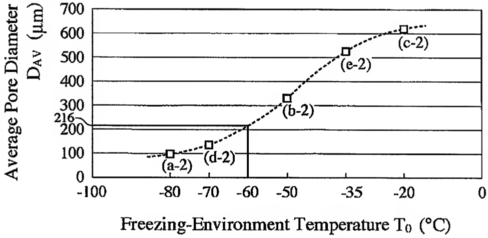


Fig. 9A



(b) A porous body sample containing a fibrous apatite/collagen composite was produced in the same manner as in Example 2, except that the freezing-environment temperature T_0 was -60°C.

The the solidification time Sb and the average pore diameter of the porous body sample were measured by the same method as in Example 2. The results are shown in Table 2 below.

Table 2

	Freezing-Environment Temperature T_0 (°C)	Solidification Time Sb (seconds)	Average Pore Diameter (μm)
Porous Body Sample	-60	1098	205.3

(c) When the average pore diameter of the porous body sample was calculated by the use of Figs. 6A and 8A, the solidification time Sb was about 1102 as shown in Fig.6A, and the average pore diameter was about 206 as shown in Fig.8A. To the contrary, when the average pore diameter of the porous body sample was calculated by the use of Figs. 9A, the average pore diameter was about 216.

[B] Discussions

As shown in Figs. 6A and 8A, the curve lines showing the relation between the freezing-environment temperature T_0 and the solidification time Sb and the relation between the solidification time Sb and the average pore diameter D_{AV} seem to be a gentle quadratic curve. To the contrary, as shown in Figs.9A, the curve line showing between the freezing-environment temperature T_0 and the average pore diameter D_{AV} is an irregularly complicated curve.

When the average pore diameter of the porous body sample was calculated by the use of Figs. 6A and 8A, which is the method of this invention using "the solidification time" as a parameter, the calculated value (206 μm) is very close to the experimental value (205.3 μm). To the contrary, when the average pore diameter of the porous body sample was calculated by the use of Figs. 9A, the calculated value (216 μm) is far from the experimental value (205.3 μm).

This indicates that the curve lines in Figs. 6A and 8A are usable as a calibration line. This reason comes from the fact that the average pore diameter is most directly correlated with solidification time, and thus less data fluctuation occurs between the average pore diameter and the solidification time. Accordingly, it can be said that the indirect method of this invention determining the freezing-environment temperature from the average pore diameter with the aid of the parameter "solidification time" can control the average pore diameter of a porous body more accurately than the direct method described in Kikuchi.

[C] Conclusion

The indirect method of this invention determining the freezing-environment temperature from the average pore diameter with the aid of the parameter "solidification time" can control the average pore diameter of a porous body more accurately than the direct method described in Kikuchi. It is thus concluded that the method of the invention recited in the amended claim 1 determining the freezing-environment temperature from the average pore diameter with the aid of the parameter "solidification time" is

pore diameter with the aid of the parameter "solidification time" is advantageous over the direct method disclosed in Kikuchi.

(10) I declare further that all statements made herein on personal knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Dated: November 05, 2010

Daisuke Shoji